



Multi-Sector Strategies for Reducing GHG Emissions in California

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Presentation Overview

- Discussion of broad-based approaches to reducing emissions/enhancing sequestration from various sectors
- Discussion of some potential approaches for sectors evaluated to date
- Conclusions and next steps

Some Broad-Based Approaches to GHG Mitigation

Mandatory Approaches

- Technology-based
- Intensity standards and benchmarks
- Cap-and-trade
- Pollution fees
- Monitoring and reporting requirements

Voluntary Approaches

- Negotiated agreements
- Incentive programs
- Voluntary programs
- Education and assistance
- Removal of barriers to GHG reductions

Technology-Based Approaches

- **Example policies:** Building codes, appliance standards, new source performance standards, new source review, ZEV/LEV programs
- **Advantages:**
 - Can mandate desired level of technical improvement from business-as-usual conditions
 - Usually applicable to an entire sector, resulting in broad-based participation in emissions reductions
- **Disadvantages:**
 - May not achieve desired reduction target depending on industry growth
 - May not achieve technological innovation because often based on known technologies
 - May encourage investment in the “wrong” technologies
 - May cost more than other mandatory programs due to lower levels of compliance flexibility



Intensity Standards and Benchmarks

- **Example policies:** emissions limit per unit of production or GDP; limits on energy use per unit of production or GDP; car GHG standards
- **Advantages:**
 - Allows for growth in industrial production and less carbon intensive
 - Can set a benchmark to require existing facilities at a given level of output to do better than estimated business-as-usual conditions
 - Can be applicable to an entire sector, resulting in broad-based participation in emissions reductions
 - Compliance flexibility possible through trading w/in the benchmarked sector
- **Disadvantages:**
 - May not achieve desired reduction target depending on level of industry growth
 - Possible to trade with capped sectors as well, but more complicated



Cap-and-Trade

- **Example policies:** Acid Rain Trading Program, RECLAIM, EU ETS
- **Advantages:**
 - Achieves specific cap level (or below), on average, over the course of the program
 - Encourages the most cost-effective (cost/ton of emissions reduced) compliance options, can stimulate technological innovation
 - Can be applicable to an entire sector, resulting in broad-based participation in emissions reductions
- **Disadvantages:**
 - Not appropriate for all sectors (e.g., sectors with many small sources of emissions or that cannot get good data on emissions)
 - Uncertainty about total cost (unless includes a price cap as well)



Pollution Fees

- **Example policies:** Emission fees, raw materials taxes, energy taxes, product and excise taxes, toll roads
- **Advantages:**
 - Raises funds that can be used to support other climate policies and measures or reduce other taxes
 - Encourages reductions that cost less than the tax
 - Encourages the most cost-effective (cost/ton of emissions reduced) compliance options
- **Disadvantages:**
 - May not achieve desired reduction target
 - Often faces stiff political opposition

Monitoring and Reporting Requirements

- **Example policies:** Toxics Release Inventory; Mandatory GHG Reporting in NJ; Motor Vehicle Inspection Programs; Product labeling
- **Advantages:**
 - » Assists with inventory development
 - » May encourage reductions from high emitters
 - » Informs consumers
 - » Provides data needed to support certain control approaches
- **Disadvantages:**
 - » Level of reduction likely to be uncertain



Negotiated Agreements

- **Example policies:** NJ Silver/Gold Track; Netherlands Energy Efficiency Benchmarking
- **Advantages:**
 - » Targets are negotiated, providing some industry flexibility
 - » Compliance is mandatory. Failure to comply may result in loss of incentives or application of penalties.
- **Disadvantages:**
 - » Participants self-select; can lead to lowest common denominator targets, overall sector emissions could increase.
 - » Targets vary in stringency

Incentive Programs

- **Example policies:** CA renewables reverse auction; Tax credits; Loan assistance, Direct government purchase of reductions (Netherlands & UK), offsets to cap & trade
- **Advantages:**
 - » Improves economics of emissions reductions, providing an incentive to change behavior
 - » Reverse auction & government purchase options provide certainty of achieving some reductions
- **Disadvantages:**
 - » Costs incurred by government and/or taxpayers can be large
 - » “free rider” problem – could be paying for “anyway” tons
 - » Hard to get sectors that begin as offset generators or recipients of payments to later accept regulation



Voluntary Programs

- **Example policies:** California registry, EPA Climate leaders,
- **Advantages:**
 - » Allows for significant compliance flexibility
 - » Educates companies about issue and benefits of reductions
- **Disadvantages:**
 - » Participants self-select; because a large part of a sector may be excluded, overall sector emissions could increase.
 - » Targets may not be particularly aggressive
 - » No penalties for non-compliance, so reduced incentive to comply



Education and Assistance

- **Example policies:** Training; Consumer Education; Environmental audits
- **Advantages:**
 - » Helps overcome knowledge barriers
- **Disadvantages:**
 - » Hard to assess impact
 - » May not achieve desired reduction target

Removal of Barriers to GHG Reductions

- In some cases, removal of policy or market barriers to technology implementation may be needed to encourage desired behaviors or to achieve mandatory GHG reductions for a given sector at a reasonable cost (e.g. blended cement, net metering)
- Such changes should be evaluated against the original purpose of the particular policies in question.

Evaluation of Measures for Specific Sectors

- We have considered alternative policy approaches for the following sectors:
 - » Transportation
 - » Forestry
 - » Agriculture
 - » Cement
 - » Manure Management
 - » Semiconductor
 - » Petroleum Refining
 - » Landfills
 - » Natural Gas Systems

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Transportation Sector Potential Policy Approaches

Key principles being discussed:

- Link bottom-up approaches w/ broad solutions (e.g., truck-stop electrification as a component in statewide freight plans)
- Coordinate climate strategies w/ other benefits of improved transportation performance (e.g., air quality, petroleum dependence)
 - » state and local policies should support these goals
- Balance short and long-term strategies
 - » The need for immediate reductions combined with long-term approaches
- Complement standards w/ incentives



Transportation Sector Promising Policy Approaches

Key Policies and Programs:

- **Mandatory Reductions & Incentives.** Require cleaner fuels/fuel blends in all state fuel coupled with the purchase/use of efficient vehicles, alternative fuel vehicles and infrastructure
 - » Examples: feebate program for light duty vehicles, funding for scrappage of older vehicles, accelerated turnover of older airplanes
- **Best Planning Practices.** Integrate climate reduction goals into transportation planning and freight planning
 - » Provide full or supplemental funding for MPO plans w/ climate-friendly measures (VMT reduction), infrastructure or design guidelines practices
 - » Examples: truck route optimization, expanding freight rail, electrification
 - This is likely to be a long-term effort
- **Prioritize policies with multiple benefits.** Rank GHG measures based on multiple criteria (e.g., petroleum savings, criteria pollutant reductions)
 - » Example: ACEEE's Green Score



Forestry Sector

Potential Policy Approaches (1)

- Require Specific Technologies or Practices
 - Could work for extending rotations
 - Less flexible than cap-and-trade and, unlike voluntary programs, could impose high costs on landowners.
- Cap-and-Trade
 - Design of the cap could be based on historic baseline years for individual lands or on historic baseline years for different vegetation/soil types.
 - Landowners would need to maintain carbon stocks at this level, or buy allowances if they go below the baseline. They could sell allowances if their stocks exceed their baseline.
 - Would only apply to larger ownerships.
 - Except after major clearing, measurements would generally not be more frequent than once every five years.
 - Rules on ownership of wood products/waste removed from land would need to be established.
 - May be politically difficult to regulate the forestry sector, even if the chosen cap level does not require an increase in sequestration.



Forestry Sector

Potential Policy Approaches (2)

- Voluntary Project-Based Sequestration
 - Could be implemented via private or state purchase of offsets
 - Through **private purchases** of sequestration offsets, capped sectors could meet their caps more cost-effectively.
 - Policy could require some share of the reductions to be retired to enhance the likelihood that this sector would make an independent, additional contribution to the state target.
 - **State purchases** of sequestration offsets would ensure reductions are additional to other programs and would help meet overall state target. However, state funds would be needed to support these actions.
 - Establishing a baseline for each project is difficult.
 - State could streamline the baseline issue by setting standard baselines for different forest types, by region



Costs of Carbon Measurements in the Forestry Sector

- Unless combined with an existing resource inventory, carbon measurements can easily cost \$10-20,000 and need to be repeated every 5-10 years
- Costs are relatively insensitive to the size of the area measured
- For forests, keeping measurement costs to \$2 per acre per year probably means requiring participation only of entities owning 1000 acres or more (for mandatory programs)

Numbers of Private Forest Landowners by Property Size, in California

Minimum Ownership Included (acres)	Number of Owners Included	Number of Acres Included	Percentage of Acres Included
10	143,078	13,288,968	91.8
50	46,656	11,624,228	80.3
100	21,773	9,901,584	68.4
500	2,419	6,528,676	45.1
1000	1,037	5,616,688	38.8



Note: The Forest Service estimates there are 23 million acres of public forest land in California. Including public lands would significantly increase the scope of the program.

Agricultural Sinks

Potential Policy Approaches

- **Requiring specific technologies** would require substantial capital spending and learning by farmers
- A **cap-and-trade** program for soil carbon would require either: (a) state determination of effects of reducing tillage on various locations and soils, or (b) creation of substantial capacity to precisely measure soil carbon stock changes
- **Voluntary** project-based sequestration can work like forestry, with somewhat less difficulty setting baselines



Manure Management

Potential Policy Approaches (1)

- **Mandatory** control approaches might focus on larger farms or just on those with liquid management systems.
- **Technology-based approaches** are possible alone or coupled with incentives. Based on ICF's analysis, covered lagoons appear to be the lowest cost approach and have a high reduction potential. Biodigesters appear to be cost-effective, but these costs do not include added costs for NOx control (lean burn engines or SCR). There are also questions about whether SCR will be sufficiently effective to meet tight NOx control standards in the Valley or whether centralized facilities can get economies of scale on NOx control.
- A **cap** for this sector would likely be based on an estimated rate per animal given the difficulties of tracking actual emissions from animals. Because of baseline problems, it might be preferable to go with a credit or offsets approach for covering lagoons and use of digesters rather than a cap.



Manure Management

Potential Policy Approaches (2)

- **Incentives** can lower the costs of mandatory control programs or provide incentives for greater participation in voluntary programs. Promising approaches include:
 - » Net metering and streamlined interconnection procedures
 - » Incentive payments to buy down capital costs or as a production tax credit
- **Voluntary approaches**, such as selling credits into a trading system, can also achieve reductions. Sharing the credits between the atmosphere and buyers could ensure a contribution to achieving an overall state target by this sector.
- **Technology demonstration** and development of **standardized technology** may also be helpful, in conjunction with a mandatory or voluntary program.



Semiconductor Industry Potential Policy Approaches

- Sector has national and international commitments to reduce emissions to 10% below 1995 levels by 2010.
- A similar voluntary commitment or mandatory requirement could be established in California.
- Alternatively, this voluntary target could be linked to a state trading system by allowing the sector to sell allowances if it does better than its voluntary target, but not be penalized if it does worse.

Petroleum Refining

Potential Policy Approaches (1)

- Mandatory emissions control could be achieved in several ways.
 - » **Technology-based approaches** would require very detailed information on the sector and may lead to product shifts and leakage to out-of-state refineries.
 - » This sector could also be **capped** as part of an upstream or downstream trading program. An **upstream** program has advantages such as comprehensive coverage and low administrative costs, however, it relies on price signals and may function like quotas on fuels production. Under a **downstream** program, there is a risk of product shifts and leakage to out-of-state refineries.

Petroleum Refining

Potential Policy Approaches (2)

- Key issues in designing a petroleum refining policy are 1) **lack of data**; and 2) **prevention of leakage**.
- **Mandatory emissions reporting** can help overcome data limitations and would be needed to support development of a mandatory control approach. Current **voluntary reporting** has had very limited participation from this sector.
- One potential compliance strategy for a petroleum refinery if faced with a hard cap might be to shift its fuel mix. Production of cleaner/lighter fuels are *more* carbon intensive than production of dirtier or heavier fuels, so the result of a hard cap could be an undesirable shift in production of these fuels from in-state to out-of-state producers.



Petroleum Refining

Potential Policy Approaches (3)

- Another mandatory control approach would be establishment of emissions **benchmarks** (emissions/unit output) based on top performing plants.
 - » Emissions/fuel carbon content would favor lighter fuels, the type already favored in California. This metric would be less likely to fundamentally shift products produced and would encourage other compliance approaches.
 - » This approach is relatively simple and does not penalize the industry for increases in fuel demand. However, emissions could increase, and if only the major fuel types are included, some emissions could be missed.

Petroleum Refining

Potential Policy Approaches (4)

- **Incentives and voluntary approaches** – other issues to evaluate:
 - » Do barriers to new refinery capacity affect production efficiency? If so, would it be desirable to consider overcoming these barriers?
 - » Incentives to encourage advanced technology and practices, such as use of non-virgin, captured carbon in enhanced oil recovery.
 - » What would be the impact on refinery emissions of encouraging biofuels to be produced at a refinery? (Federal tax benefits currently are only available to ag producers.)

Landfills

Potential Policy Approaches

- Due to measurement difficulties for both large and small landfills, this source could not be easily included in an allowance-based **cap-and-trade** system. Other **mandatory** approaches (e.g., technology-based approaches) may be more viable.
- Where gas capture systems are in place, measurement of emissions reductions can be readily determined, making a **voluntary credit-based system** technically viable, though additionality issues would need to be resolved. Also, a voluntary program may not capture all or most of the emissions from this sector.
- A third approach is a **hybrid** allowance and credit-based system in which initial allowance requirements are based on gross emissions using indirect measures and adjusted for CH₄ captured pursuant to existing requirements. For smaller landfills, credits could be earned for gas collection and flaring, and additional credits could be awarded if beneficial use is made of the gas. For sources already reducing emissions, credits would be restricted to beneficial use of the gas.

Natural Gas Systems

Potential Policy Approaches (1)

- The extensive scope of the natural gas system in the US poses a substantial challenge for administering broad-based **mandatory** control programs. Moreover, on a per-component basis, emissions are small.
 - » For example, EPA's national estimate of 33.2 MMTCO₂e results from a natural gas distribution system that spans a network of 1.5 million miles of distribution pipeline and over 40 million customer meters. Leaks are small but numerous, irregularly distributed, and difficult to track and measure.
- Compressor stations, a subsector of the natural gas system, may be more easily included in a **mandatory** control program because they are relatively significant, small in number, and easy to measure. However, further improvements may be needed in the accuracy and efficiency of leak detection.
- Use of a **voluntary** credit-based approach alone would result in a lack of coverage.



Natural Gas Systems

Potential Policy Approaches (2)

- A third option is a **hybrid** approach, combining an allowance based system using indirect methods and activity factors in conjunction with volumes of gas at a facility or distribution stage, with a credit-based system.
- Another approach is to **increase the emissions factor** used to calculate CO₂ emissions from the combustion of natural gas for downstream fuel users from 117 lbs. CO₂/MMBtu to about 125 or 126 lbs. CO₂/MMBtu. To ensure there are also incentives to make reductions upstream, this emission factor increase could be **combined with a voluntary credit-based approach**.

Cement Sector

Potential Policy Approaches (1)

- **Requiring specific technologies** may be less effective in cement due to significant technological variations across facilities.
- Emissions **benchmarking** per unit of output (i.e., clinker, cement, or both) could achieve reductions from this sector but would not guarantee a decrease in emissions.
- The cement industry may be well-suited to **cap-and-trade** given the relatively small number of plants. However, additional research is needed to understand the degree to which leakage would occur and whether or not any leakage is likely to result in a net increase in emissions. Border adjustments are a possible remedy if leakage is believed to have adverse effects, though such adjustments are difficult to implement.
- Existing **voluntary** national industry commitments could be replicated at the state level, or the sector could be treated as an offset. However, such treatments may not achieve the desired emissions reductions from this sector in California.

Cement Sector

Potential Policy Approaches (2)

- Under either a mandatory or voluntary control approach, the following measures are needed to **overcome barriers** to emissions reductions:
 - » For limestone Portland cement and blended cement, the state should codify their use in public-works projects and encourage it in the private sector.
 - » For waste tires as fuel, the state should take a more active role in explaining the benefits of their use (reduced CO₂ emissions due to reduced coal consumption, reduced air pollution from open tire burning, reduced mosquito vectors) to the public.
 - » Also to encourage waste tires as fuel, the state should demonstrate to the public that kiln combustion of waste tires results in the cited environmental benefits.



Conclusions

- Broad-based participation and use of mandatory control approaches will increase the likelihood of meeting an emissions target.
- Some mandatory and voluntary approaches (or hybrids) are better suited to some sectors than others, both technically and politically.
- Measures can be used alone or in combination. Combining measures can create synergies and reduce industry resistance.

Next Steps

- Collect and incorporate feedback on sectors evaluated to date
- Evaluate power sector policy options
- Integrate transportation w/other state programs (e.g., Good Movement Action Plan, AB 1493 etc.) or national action (e.g., fuel economy standards)